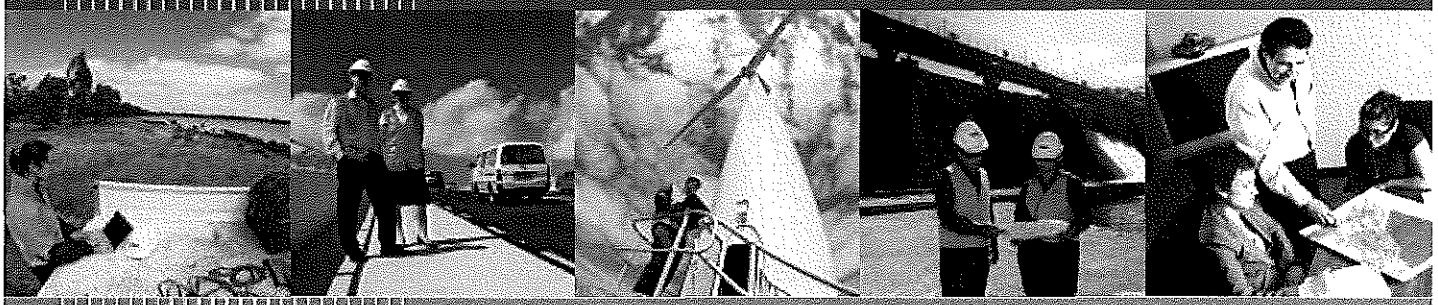

# West-East Rail Feasibility Study

## Part 1 - Route Assessment

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Prepared for

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URS

# Executive Summary

The basis of this study is to establish four feasible rail alignments from Kwinana to the Great Southern Railway (GSR), and then four feasible alignments from the GSR to the Eastern Goldfields Railway (EGR) within specified boundaries.

The study encompasses six basic elements:

1. Policy review and communication
2. Data collection and route identification
3. Constraints analysis
4. Preliminary alignment design
5. Costings
6. Evaluation and recommendation.

In order to inform the route identification process a comprehensive geographical information system (GIS) management system was produced providing a functional archive and repository for all investigation data as well as being a valuable analytical tool for alignment and option evaluation. The GIS database formed a platform for the first screening of the West-East alignments. In addition to the GIS database, a broad scale Digital Elevation Model (DEM) was prepared from elevation data sourced from various authorities.

## Design Criteria

The design criteria set by DoT requires a preferred ruling grade of no greater than 1:200 with 1:150 being the absolute maximum. Therefore routes with a ruling gradient steeper than 1:150 were discounted.

## Identification of routes

The West-East route identification process has been undertaken in two parts:

- Identification of routes between Kwinana and the GSR, and
- Identification of routes between the GSR and the EGR

### *Kwinana to the GSR*

Given the nature of the landscape across the Darling Ranges from Kwinana it was considered that potential route options would be initially constrained by the land form and topography. A total of 16 potential routes through the Darling Ranges were identified. From the 16 routes identified a long section profile was extracted with the ruling gradients identified on each. A total of two routes met the required gradient, Murray River from Coolup to Boddington and a route that travels via the Escarpment.

Due to the limited number of routes through the Darling Ranges which met the gradient design criteria (1:150 absolute maximum), at DoT's request, URS identified potential routes which met narrow gauge design standards, specifically a ruling gradient of 1:120 and a maximum of 1 in 40 in the empty direction (away from Kwinana). A total of three routes were identified which met the narrow gauge gradient criteria.

### GSR to the EGR

The routes from the GSR to EGR were less constrained by the land form and topography as the eastern Wheatbelt area has far less challenging terrain. The predominant factors influencing railway alignment location was that of distance and a desire to optimise some of the existing narrow gauge corridors. A total of six potential routes through the eastern Wheatbelt were identified.

In addition to identifying new routes through the wheat belt, the option to upgrade the existing GSR from Pingelly (linking in with the dual gauge option from Kwinana) to Northam from narrow gauge to dual gauge was considered as part of this study.

### Constraints Analysis

Through the use of GIS, further analysis was undertaken to establish the best routes based on indexed attributes of opportunities and constraints, which were analysed and presented within a constraints matrix. The constraints identified, assessed and ranked during the options selection were as follows:

- Environmental
  - Water supply
  - Conservation
  - Flora and fauna
- Geotechnical
  - Interference with existing mining operations
  - Stability of earthworks
  - Weathering and swelling risk factors for soil and clays
  - Expected cut and fill
  - Surface water run off
  - Seismic risks
  - Maintenance costs
- Heritage
  - Aboriginal heritage
  - European heritage
- Land Use and Tenure
  - Local Authority Town Planning Schemes and Strategies
  - Region Schemes

Where a number of route options were available the constraints matrix was used to identify the most suitable alignment options to be taken through to the preliminary design stage.

A total of eleven interconnecting routes between Kwinana and the EGR were taken through to the preliminary design stage, giving the DoT a 'shopping list' of options, on a mix and match basis. Two narrow gauge options from Kwinana to the GSR were also taken through to the preliminary design stage.

### *Preliminary Design and Costing*

The rail corridors were worked into geometric alignment strings, both horizontally and vertically, using *Bentley Rail Track* design software.

The earthwork volumes calculated at the preliminary design stage were used to calculate a P50/P90 cost estimate for each route. An elemental approach for the buildup of cost estimates was adopted. An industry standard rail infrastructure cost structure was applied which included:

- Estimates of direct costs including earthworks, permanent way (including track, sleepers, ballast formation), level crossings, turnouts, bridges and culverts.
- Allowances for indirect costs including typical allowances for preliminaries, design and other typical mark-up items including margin, offsite overhead and contractor's contingency.
- Allowances for project owner or client's costs including project management costs for development and for delivery phases, land acquisition, project contingency assessment (for scope uncertainty) and other stakeholder management costs, if necessary.

The Monte-Carlo simulation technique was used to derive a range of possible cost outcomes for each of the options.

### *Preferred Alignment Evaluation*

The route options taken through to the preliminary design and costing stages were evaluated in order to identify a preferred option linking Kwinana to the EGR. A preferred narrow gauge option connecting to the GSR was also evaluated.

Of the eleven interconnecting standard/dual gauge routes identified, a total of seven combinations connecting Kwinana to the EGR were identified. Each combination was compared, taking into account route length, cost and environmental/social constraints.

The evaluation process identified a new dual gauge route between Coolup, Boddington, Pingelly and Northam as the preferred Kwinana/GSR - GSR/EGR connection. The section of route between Pingelly and Northam assumes an upgrade of the existing GSR from narrow gauge to dual gauge. As well as representing the preferred option in terms of cost and distance, this option represents one of the best alternatives in terms of environmental and social impact. No major constraints were identified along the length of the route.

Two narrow gauge route options connecting Kwinana to the GSR were identified; Jarrahdale to Pingelly and Collie to Narrogin via Williams. The route from Jarrahdale was identified as the preferred option based on cost and distance, offering the most direct route to the GSR.

# 11 CONCLUSIONS

## 11.1 Study conclusions

There are no compelling economic arguments to support the development of any of the nominated alternative rail corridors, due to the inherent disadvantages of each corridor relative to the existing corridor. These disadvantages principally relate to additional distance into the key locations of Perth (Kewdale) and Kwinana.

All corridors offer the capacity to capture significant volumes of grain which would otherwise travel by road to port, or less efficiently on the existing network. This grain originates in the Tier 3 region, and use of a new corridor would generate some economic benefits. However, in none of the cases do these benefits outweigh the very significant capital costs associated with the construction of a new route down the escarpment.

The new volume assumptions built into the base case and sensitivity test cases are substantial, and are by no means likely to emerge in reality. Even if they do, there is little reason to suspect that a new line will be necessary, relative to the alternative option of increasing capacity on the existing network, via grade separated road crossings and additional passing loops.

The criteria for route selection applied to Stage 1 of this study required that the vertical and horizontal gradients be no greater than those that 'rule' the train operations on the existing corridor. This restriction has meant that all scenarios are circuitous and further south than would be ideal.

If any future analysis of this nature is to be done, it is suggested that additional sets of criteria be considered, so that any additional potentially cost-effective routes could be brought within the specification. Most of the potential freight growth that would be of a scale to warrant a new corridor would be bulk minerals export freight, travelling in a westerly direction. A new corridor would not need to cater for loaded trains in the return direction. The design of the new corridor could therefore be related to the operational needs of this subset of freight volume, rather than catering to the full range of freight haulage currently handled by the existing dual gauge corridor.